UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/820,911	04/08/2004	Michael E. Littau	31162-11-US	8761

5179 7590 12/22/2005

PEACOCK MYERS, P.C.
201 THIRD STREET, N.W.
SUITE 1340
ALBUQUERQUE, NM 87102

EXAMINER	
STOCK JR, GORDON J	

ART UNIT	PAPER NUMBER
2877	

DATE MAILED: 12/22/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/820,911	LITTAU ET AL.	
	Examiner	Art Unit	
	Gordon J. Stock	2877	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 October 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-77* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-77* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 April 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. The amendment filed October 19, 2005 has been entered into the record.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. **Claims 1-28, 32, 33, 35-42** are rejected under 35 U.S.C. 102(b) as being anticipated by **Littau et al (6,429,930)—previously cited.**

As for **claims 1-4, and 22** Littau discloses the following in a determination of center of focus by diffraction signature analysis: providing a substrate, a wafer, comprising a plurality of fields, a plurality of dies, with each field having been exposed at differing exposure and focus conditions and comprising a plurality of single period diffraction gratings formed on the substrate through a lithographic process; measuring the diffraction signature for each of a plurality of the diffraction structures in a plurality of fields with a range of intensities measured (column 7, lines 1-20; Figs. 5a-5c); wherein each set of diffraction structures may be at the same focus setting within that particular field or die (Fig. 1B: 20 and 15; Fig 1A: 10, 15; col. 9, lines 17-25); determining for each field the variability of measured diffraction signatures obtained from the plurality of diffraction surfaces located within the field; and comparing variabilities associated with the fields to determine a desired parameter (column 7, lines 5-15).

As for **claims 5-13**, Littau discloses everything as above (see **claim 1**). In addition, Littau discloses a radiation source-based tool such as a light source based tool that may be an

incident laser beam source with scanning through a plurality of incident angles (column 8, lines 45-50; column 4, lines 55-65; column 5, lines 1-20); by means of a radiation source-based tool such as a light source based tool that may be an incident laser beam source with scanning through a plurality of incident angles (column 8, lines 45-50; column 4, lines 55-65; column 5, lines 1-20); the system may be an angle-resolved scatterometer, that has an optical system for focusing beam and a detector (column 4, lines 55-65: Fig. 2: light source and detector); a plurality of laser sources may be used (column 8, lines 45-50); a broad spectral light source may be used with a range of wavelengths (column 4, lines 62-65); the S and P polarizations amplitude and phase may be varied with variable phase detection (column 5, lines 1-5); a variable sweep or variable angle of incidence may be used with a broad or narrow wavelength light source (column 5, lines 8-15).

As for **claims 14-18**, Littau discloses everything as above (see **claim 1**). In addition, Littau discloses the diffraction signature may be reflective, transmissive, specular, higher order and scatter is measured via scatterometry (column 8, lines 30-65; column 9, lines 1-10).

As for **claims 19-20**, Littau discloses everything as above (see **claim 1**). In addition, he discloses the desired parameters may be dose and center of focus (column 6, lines 65-67; column 7, lines 1-20).

As for **claims 21, 23, and 24,** Littau discloses everything as above (see **claim 1**). In addition, he discloses the desired parameter is determined through the minimal variability; a statistical measure such as root mean square error is performed (column 11, lines 5-15).

As for **claims 25 and 26**, Littau discloses everything as above (see **claim 1**). In addition he discloses forming the diffraction structures at known different focus settings and

known different dose settings and determining the effect of dose on focus and having sets of same known different focus settings with sets varying by different known dose settings (col. 9, lines 10-30; col. 13, lines 1-20).

As for **claims 27, 28, 32, 33**, Littau discloses everything as above (see **claim** 1). In addition, he discloses a library of theoretical diffraction signatures are used (column 13, lines 34-40); a chosen feature is CD and determining for each field the variability of the chosen feature associated with the plurality of diffraction structures located within that field (col. 2, lines 15-30; col. 3, lines 20-35; col. 13, lines 50-67); a statistical measure such as root mean square error is performed (column 11, lines 5-15).

As for **claims 35 and 36,** Littau discloses everything as above (see **claim 1**). In addition, Littau discloses latent imagery is used and that the substrate has not been subjected to development process (column 9, lines 40-67).

As for **claims 37-42**, Littau discloses everything as above (see claim 19). In addition, Littau discloses the center of focus is determined and adjusted with computer control and autofocus based on predetermined values versus the variability determined (column 14, lines 5-15); wherein measurements are over illumination time for variability of measured diffraction signatures (col. 13, lines 5-22; col. 1, lines 50-55); wherein a selected field was previously determined to be at a center of focus (col. 13, lines 5-10); wherein focus is adjusted if the variability exceeds a predetermined control limit (col. 14, lines 5-15).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. **Claims 29-31 and 34** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Littau et al (6,429,930)—previously cited.**

As for **claims 29-31, and 34,** Littau discloses everything as above (see **claims 27 and 33**). He is silent concerning standard deviation, cross section area, cross section volume, or a product of two features. However, he discloses that well known metrics are used (column 4, lines 1-10). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to have the system have standard deviation for standard deviation is a well known statistical method for analyzing data and to determine its accuracy. Littau also states that profile and CD may be found (col. 2, lines 15-30; col. 3, lines 20-35; col. 13, lines 50-67). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made that the system found cross section area, cross section volume, or a product of two, for the system finds a profile and CD; whereas, volume and area are profile features and volume is the product of area and height profiles.

6. **Claims 43-77** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Littau et al (6,429,930)—previously cited** in view of **Kroko (4,759,626)—cited by applicant.**

As for **claims 43, 48, 49, 50, and 65,** Littau discloses the following in a determination of center of focus by diffraction signature analysis: providing a substrate, a wafer, comprising a plurality of fields, a plurality of dies, with each field having been exposed at differing exposure and focus conditions and comprising a plurality of single period diffraction gratings formed on the substrate through a lithographic process; measuring the diffraction signature for each of a

plurality of the diffraction structures in a plurality of fields with a range of intensities measured (column 7, lines 1-20; Figs. 5a-5c); wherein each set of diffraction structures may be at the same focus setting within that particular field or die (Fig. 1B: 20 and 15; Fig 1A: 10, 15; col. 9, lines 17-25); determining for each field the variability of measured diffraction signatures obtained from the plurality of diffraction surfaces located within the field; and comparing variabilities associated with the fields to determine a desired parameter (column 7, lines 5-15). As for using a series of wafers, he is silent. However, he does mention testing for other aberrations and tilt in the system (col. 13, lines 23-33). And Kroko in a determination of best focus for step and repeat projection aligners teaches using a plurality of wafers to measure field curvature, tilt, and astigmatism (col. 6, lines 18-37). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to use a series of wafers in order to characterize the astigmatism, field curvature, and tilt of the lithographic system.

As for **claims 44 and 47**, Littau in view of Kroko discloses everything as above (see **claim 44**). In addition, Littau discloses the desired parameters may be dose and center of focus (column 6, lines 65-67; column 7, lines 1-20). And Littau discloses the center of focus is determined and adjusted with computer control and autofocus based on predetermined values versus the variability determined (column 14, lines 5-15).

As for **claims 45 and 46**, Littau in view of Kroko discloses everything as above (see **claim 44**). In addition, Littau discloses empirically determined variability limits (Figs. 6-9) and theoretically determined variability limits (col. 13, lines 34-42).

As for **claims 51-59**, Littau in view of Kroko discloses everything as above (see **claim 43**). In addition, Littau discloses a radiation source-based tool such as a light source based tool

that may be an incident laser beam source with scanning through a plurality of incident angles (column 8, lines 45-50; column 4, lines 55-65; column 5, lines 1-20); by means of a radiation source-based tool such as a light source based tool that may be an incident laser beam source with scanning through a plurality of incident angles (column 8, lines 45-50; column 4, lines 55-65; column 5, lines 1-20); the system may be an angle-resolved scatterometer, that has an optical system for focusing beam and a detector (column 4, lines 55-65: Fig. 2: light source and detector); a plurality of laser sources may be used (column 8, lines 45-50); a broad spectral light source may be used with a range of wavelengths (column 4, lines 62-65); the S and P polarizations amplitude and phase may be varied with variable phase detection (column 5, lines 1-5); a variable sweep or variable angle of incidence may be used with a broad or narrow wavelength light source (column 5, lines 8-15).

As for **claims 60-64**, Littau in view of Kroko discloses everything as above (see **claim 43**). In addition, Littau discloses the diffraction signature may be reflective, transmissive, specular, higher order and scatter is measured via scatterometry (column 8, lines 30-65; column 9, lines 1-10).

As for **claims 66 and 67**, Littau in view of Kroko discloses everything as above (see **claim 43**). In addition, Littau discloses the desired parameter is determined through the minimal variability; a statistical measure such as root mean square error is performed (column 11, lines 5-15).

As for **claims 68, 69, 73, 74,** Littau in view of Kroko discloses everything as above (see **claim 43**). In addition, Littau discloses a library of theoretical diffraction signatures are used (column 13, lines 34-40); a chosen feature is CD and determining for each field the

variability of the chosen feature associated with the plurality of diffraction structures located within that field (col. 2, lines 15-30; col. 3, lines 20-35; col. 13, lines 50-67); a statistical measure such as root mean square error is performed (column 11, lines 5-15).

As for **claims 70-72 and 75**, Littau in view of Kroko discloses everything as above (see **claim 68**) Littau is silent concerning standard deviation, cross section area, cross section volume, or a product of two features. However, he discloses that well known metrics are used (column 4, lines 1-10). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to have the system have standard deviation for standard deviation is a well known statistical method for analyzing data and to determine its accuracy. Littau also states that profile and CD may be found (col. 2, lines 15-30; col. 3, lines 20-35; col. 13, lines 50-67). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made that the system found cross section area, cross section volume, or a product of two, for the system finds a profile and CD; whereas, volume and area are profile features and volume is the product of area and height profiles.

As for **claims 76 and 77,** Littau in view of Kroko discloses everything as above (see **claim 74**). In addition, Littau discloses latent imagery is used and that the substrate has not been subjected to development process (column 9, lines 40-67).

Response to Arguments

7. Applicant's arguments filed October 19, 2005 have been fully considered but they are not persuasive. Specifically, the argument on page 2 of Remarks in regards to claim 1 that Littau does not teach a variability of diffraction signatures obtained from a plurality of diffraction structures in a given field, all of which structures have the same focus value, be compared with

the variability associated with fields having other focus values, Examiner disagrees. See column 7, lines 1-20; Figs. 5a-5c; and Fig. 1B: 20 and 15; Fig 1A: 10, 15; col. 9, lines 17-25. As for sets of gratings having their variability compared see Fig. 6; wherein, the variability using RMSE is plotted against focus. In addition, applicant states that variability is different from variation; however, applicant discloses that variability is a comparison of variation using statistical methods such as RMSE (page 25, lines 8-20). Littau does this as seen in Fig. 6 for the statistical variations (variability) in RMSE is plotted against focus.

As for claim 43 on page 2 of Remarks, applicant states that the variabilities associated with multiple wafers are compared are not taught by Littau or Kroko, Examiner disagrees. In response to applicant's argument that Littau or Kroko solely teach the specific limitation of variabilities associated with multiple wafers are compared, the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). As for using a series of wafers, Littau is silent. However, he does mention testing for other aberrations and tilt in the system (col. 13, lines 23-33). And Kroko in a determination of best focus for step and repeat projection aligners teaches using a plurality of wafers to measure field curvature, tilt, and astigmatism (col. 6, lines 18-37). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to use a series of wafers in order to characterize the astigmatism, field curvature, and tilt of the lithographic system.

Lastly, on the last paragraph of page 2 and page 3 of Remarks, applicant states that Littau does not teach determining variability of a given set or plurality of signatures taken at the same focus setting. Again, Examiner disagrees. See Fig. 6 of Littau and Littau teaches wherein each set of diffraction structures may be at the same focus setting within that particular field or die (Fig. 1B: 20 and 15; Fig 1A: 10, 15; col. 9, lines 17-25).

Conclusion

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Fax/Telephone Numbers

If the applicant wishes to send a fax dealing with either a proposed amendment or a discussion with a phone interview, then the fax should:

1) Contain either a statement "DRAFT" or "PROPOSED AMENDMENT" on the fax cover sheet; and

2) Should be unsigned by the attorney or agent.

This will ensure that it will not be entered into the case and will be forwarded to the examiner as quickly as possible.

Papers related to the application may be submitted to Group 2800 by Fax transmission. Papers should be faxed to Group 2800 via the PTO Fax machine located in Crystal Plaza 4. The form of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The CP4 Fax Machine number is: **(571) 273-8300**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gordon J. Stock whose telephone number is (571) 272-2431. The examiner can normally be reached on Monday-Friday, 10:00 a.m. - 6:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory J. Toatley, Jr., can be reached at 571-272-2800 ext 77.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private Pair system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

gs
December 20, 2005

Gregory J. Toatley, Jr.
Supervisory Patent Examiner
Art Unit 2877